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ORIGINAL RESEARCH

Pregnancy-Related-Acute Kidney Injury in Jigawa, Nigeria

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Abstract

Introduction: Pregnancy-related acute kidney injury (PR-AKI) is a significant cause of maternal morbidity and mortality.

Objective: This study aimed to determine the causes and outcomes of PR-AKI management.

Methods: This was a two-year retrospective review of patients managed for PR-AKI between 1 October 2021 and 31 September 2023 in the Department of Obstetrics and Gynaecology of Rasheed Shekoni Federal University Teaching Hospital Dutse. Patients' data were obtained from their case files.

Results: One hundred and three women were diagnosed with PR-AKI out of 1,647 admissions during the review period. The mean age of the patients was 27 ± 7.5 years, with an age range of 15 to 48 years. The mean parity was 4.51 ± 3.2 and most (47.6%) patients were grand-multipara. The majority (70.7%) booked for antenatal care in primary healthcare centres, and only 2(3.1%) booked in tertiary hospitals. The commonest cause of PRAKI was obstetric haemorrhage (48.5%), with postpartum haemorrhage and antepartum haemorrhage accounting for 72% and 28%, respectively. Seventy-five (72.8%) patients received a blood transfusion, while 28 (27.2%) had haemodialysis. Thirty-five (33.9%) deaths were recorded.

Conclusion: This study revealed that PRAKI was common, and obstetric haemorrhage, hypertensive disorders and sepsis were the leading causes.

Keywords: Acute Kidney Injury, Haemorrhage, Haemodialysis, Uraemia, Sepsis.

Introduction

Acute Kidney Injury (AKI) is a major global public health problem defined as acute reversible loss of kidney functions, which results in retention of urea and other nitrogenous waste

products and dysregulation of extracellular volume and electrolytes. [1, 2] Occurrence of AKI during pregnancy, labour, delivery and or the postpartum period is termed pregnancy-related acute kidney injury (PR-AKI). PR-AKI is a life-threatening obstetric complication that is

associated with 30-60% of maternal and foetal mortality globally. [3,4]

Improvements in obstetric, prenatal and medical care, as well as a decline in the septic abortion rate, have decreased the incidence of PR-AKI in the past 50 years.^[5] PRAKI is more common in developing countries, with a reported incidence of 4% to 26%, and less common in developed countries, with a lower incidence of 1% to 2.8%.^[6] The higher incidence in developing countries is attributed to poverty, poor education, lack of health facilities, deficiencies in obstetric and medical care, delayed referral process and lack of awareness of the condition.^[7]

However, PR-AKI is rising again in the developed countries. The incidence in the United States has increased from 2.3/10,000 deliveries to 4.5/10,000 deliveries between 1998 and 2008. ^[8] Factors that have been attributed to the rising PR-AKI in developed countries include increasing pregnancy among women of advanced maternal age with pre-existing diabetes mellitus, obesity and chronic hypertension ^[9] and also increased use of assisted reproduction, particularly ovulation induction. ^[10] The incidence of PR-AKI in Morocco is 6.6 per 1000 delivery. ^[11] The reported incidence in Gusau, Northwest Nigeria, in the context of all cases of AKI, was 19.7%. ^[12]

PR-AKI may occur during pregnancy or in the postpartum period. The causes of PR-AKI in early pregnancy include sepsis and anaemia complicating abortion, ovarian hyperstimulation syndrome and ectopic pregnancy. While in late pregnancy, the causes are abruption placentae, placenta previa, hypertensive disorders of pregnancy, especially severe preeclampsia (SPE) and Haemolysis, Elevated Liver Enzymes, Low Platelet count (HELLP) syndrome and pyelonephritis. The causes in the postpartum period include puerperal sepsis, postpartum haemorrhage (PPH), severe preeclampsia/eclampsia and nephrotoxic drugs.

^[13, 14] Rarely, PRAKI is attributed to acute fatty liver of pregnancy, atypical haemolytic uraemic syndrome and thrombotic thrombocytopenic purpura. ^[15]

Hypertensive disorders are the leading causes in developed countries, whereas in developing countries, sepsis and haemorrhage are the main contributors ^[16-18] However, the causes vary from one region to another. Sepsis accounts for 41.7 - 63.1% in India, ^[19] while haemorrhage (46.0%) was the most common cause of PRAKI in Gusau, Northwest Nigeria. ^[12] PR-AKI of any aetiology can be severe and, in some cases, lead to the need for dialysis, plasma exchange or renal transplant. ^[20] The need for dialysis of any duration is estimated to be between 0 to 47%. ^[21] The indications for dialysis include volume overload, non-responsiveness to diuretics, hyperkalaemia, metabolic acidosis refractive to medical treatment and symptomatic uraemia (manifested as pericarditis, encephalopathy or neuropathy). ^[14] This study aimed to determine the causes and outcome of the management of PR-AKI at Rasheed Shekoni Federal University Teaching Hospital Dutse, Northwest Nigeria.

Methods

This was a two-year retrospective review of patients managed for PR-AKI between 01 October 2021 and 31 September 2023 in the Department of Obstetrics and Gynecology of Rasheed Shekoni Federal University Teaching Hospital (RSFUTH) Dutse. RSFUTH is one of the tertiary health facilities in Jigawa state. It has an established dialysis centre with seven dialysis machines and provides an average of 10 dialysis sessions daily.

The study participants included all patients managed for PR-AKI at RSFUTH during the review period. Patients with underlying chronic kidney disease (CKD) were excluded from the

study. Patients were identified from the ward admission list and dialysis register. Patients' data were obtained from the case records using a structured proforma. The relevant information obtained included socio-demographic characteristics, obstetric history, clinical profile, investigations, treatment and outcome.

Definition of terms

AKI was defined as an increase in serum creatinine by 0.3mg/dl or more within 48 hours, an increase in serum creatinine to 1.5 times the baseline value or more within the last seven days and urine output <0.5ml/kg/hour for six hours or oliguria (urine output <400ml/ 24 hour). PRA-KI was defined as AKI occurring in pregnancy or puerperium.

Outcomes

The evaluated outcomes included full renal recovery, maternal mortality, the requirement for continuous renal replacement therapy (RRT), and discharge against medical advice (DAMA). Full recovery was defined as a decline in serum creatinine level to ≤ 1.0 mg/dl within six weeks of diagnosis of AKI.

Statistical analysis

Data analysis was done using the IBM Statistical Package for Social Sciences (SPSS) version 26. Measured variables were expressed in frequencies and percentages. Test for association was done using a Chi-square non-parametric test, setting the p-value at < 0.05.

Ethical approval

The study received ethical approval from the Research Ethics Approval Committee of RSFUTH Dutse, Nigeria (RSFUTH/GEN/226/V.II).

Results

A total of 103 women were diagnosed with PR-AKI out of 1,647 admissions into the Obstetrics and Gynaecology (O&G) wards during the review period. The prevalence of PR-AKI in this study was 6.25%. The mean age of the patients was 27 ± 7.5 years, with an age range of 15 to 48 years. Most (72.8%) were between 20-29 and 30-39 years of age. This is shown in Table I below.

Table I: Age of the women with PR-AKI

Age	Frequency	Percentage
≤ 19	19	18.5
20-29	40	38.8
30-39	35	34.0
≥ 40	9	8.7
Total	103	100

The mean parity was 4.51 ± 3.2 , with a range of 1 to 12. Most (47.6%) of the patients were grand-multipara. A significant number (63.1%) of the patients received antenatal care (ANC). Additionally, 71(69%) of the patients delivered in the hospital, among which the majority (88.7%) were vaginal delivery and 8 (11.3%) were by Caesarean section as shown in (Table II).

The commonest (48.5%) cause of PR-AKI in this study was obstetric haemorrhage, with postpartum and antepartum haemorrhage (APH) accounting for 72% and 28%, respectively. Other causes of PR-AKI included hypertensive disorders of pregnancy (34%) and sepsis (17.5%). This is shown in Table III.

As shown in Table IV, the mean packed cell volume (PCV) was $22.7 \pm 4.8\%$, with a range of 12%- 33%. The mean serum creatinine, urea, potassium, and bicarbonate were $623.9 \pm 4.3 \mu$ mmol/L, 21.6 ± 8.8 mmol/L, 4.3 ± 0.9 mmol/L, and 15.2 ± 7.2 mmol/L, respectively.

Table II: Obstetric characteristics of the patients with PR-AKI

<i>Characteristics</i>	<i>Frequency (n)</i>	<i>Percentage</i>
Primipara	27	26.2
Multipara	27	26.2
Grand-multipara	49	47.6
Booking status		
Un-booked	38	36.9
Booked	65	63.1
Educational Qualification		
Primary	46	70.7
Secondary	17	26.2
Tertiary	2	3.1
Place of Delivery		
Home	32	31.0
Hospital	71	69.0
Caesarean section	8	11.3
Vaginal delivery	63	88.7

Table III: Aetiological factors in PR-AKI

<i>Factors</i>	<i>Frequency</i>	<i>Percentage</i>
Obstetric haemorrhage	50	48.5
PPH	36	72.0
APH (Abruptio)	14	28.0
Hypertensive disorders	35	34
Eclampsia	21	60.0
SPE	10	28.6
PIH	4	11.4
Sepsis	18	17.5
Puerperal sepsis	17	94.4
Post-abortion sepsis	1	5.6

SPE - Severe Pre-Eclampsia; PPH - Postpartum Haemorrhage; APH - Antepartum Haemorrhage; PIH - Pregnancy-induced hypertension

Forty-nine (47.5%) patients required hemodialysis (HD); however, only 28(27.2%) patients had HD. The mean HD session was 2.9±1.6. The majority (46.5%) had three sessions. This is shown in Table V. The majority (43.7%) of the patients recovered and were discharged home; 20 (19.5%) were discharged against medical advice (DAMA), and three women (2.9%) were referred because of a positive serology test. Thirty-five (33.9%) deaths were

recorded. The causes of death were uraemic encephalopathy, hypovolaemic shock, disseminated intravascular coagulopathy (DIC) following sepsis and pulmonary oedema. Of the 28 (27.2%) patients that had dialysis, 17 had a complete renal recovery, three were DAMA, one was dialysis-dependent, and there were seven mortalities. The causes of death were uraemic encephalopathy (4), pulmonary oedema (2) and DIC (1). Fifty-four (52.8%) patients did not have

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an indication for dialysis, and their management involved volume resuscitation, correction of hyperkalaemia and acidosis, antibiotics, and

blood transfusion. Of these 54 patients, 28 had complete renal recovery, 2 were DAMA, and there were 14 mortalities.

Table IV: Mean, range and categories of Packed Cell Volumes (PCV) and serum levels of electrolytes

Investigation	Frequency (n)	Percentage
PCV (%) Mean = 22.7±4.8, range = 12% - 33%		
≥ 33	6	5.8
30-32.9	6	5.8
21-29.9	62	60.2
≤21	29	28.2
Creatinine (mmol/L), Mean = 623.9±4.3, range 87-1647		
A - Normal	3	2.9
B - Abnormal	100	97.1
< 700	64	64.0
≥700	36	36.0
Urea (mmol/L) Mean = 21.6 ± 8.8, range = 2.8-48.9		
A - Normal	5	4.8
B - Abnormal	98	95.2
<30	82	83.6
≥30	16	16.4
Potassium (mmol/L), Mean 4.3±0.9, range = 2.6-7.2		
A - Normal	74	71.8
B - Abnormal	29	28.2
Hyperkalaemia	25	86.2
Hypokalaemia	4	13.8
Bicarbonate (mmol/L), mean = 15.2±7.2, range 8 - 48		
Normal	34	33.1
Low	67	65.0
High	2	1.9

Table V: Haemodialysis sessions in patients with PRA-KI

Treatment modality	Frequency	Percentage
Haemodialysis (HD) sessions		
Required HD	49	47.5
Received HD	28	27.2
Number of HD sessions (n = 28)		
1	5	17.8
2	5	17.8
3	13	46.5
4	2	7.2
5	3	10.7

Discussion

The prevalence of PRAKI in the context of obstetrics and gynaecology admissions is 6.25%. A study in Pakistan reported that the incidence is

higher than 1.10%.^[22] However, it is lower than the 19.7% and 33.3% reported in Gusau and Osogbo, respectively, both in Nigeria.^[12, 24] The disparity in the prevalence could be explained by the fact that the Gusau study looked at the incidence of PRAKI in the context of cases of AKI, and the Osogbo study looked at dialysis requiring AKI.

The mean age of the patients with PRAKI in the present study was 27 ± 7.5 years. This is similar to 28.6 ± 6.1 years reported by Omar *et al.* in Somalia.^[23] Additionally, the age range was 15 to 48 years, contrasting with some studies' findings with a narrower age range.^[12, 13, 24] The wide age range in the current study could be related to the culture of early marriage and childbirth practised in the setting of the study. More so, the PRAKI patients aged 20-29 years had the highest (38.8%) age-based prevalence. This is comparable to 20-30 years reported by Omafir *et al.*^[23] The majority of the patients were grand-multipara, in contrast to the findings of some studies in which most were primipara.^[13, 25] This may be explained by the survey's finding that the leading cause of PRAKI was obstetric haemorrhage, which is more attributed to high parity.

Many studies reported the occurrence of PRAKI predominantly in the postpartum period and in the third trimester of pregnancy.^[11, 12, 22, 26-29] However, in the current study, all PRAKI cases were referred and diagnosed in the postpartum period, except for a case that occurred following first trimester abortion.

The majority of the PRAKI patients in this study had antenatal care. Similarly, Mahesh *et al.* in India reported a high rate (93%) of ANC attendance among PRAKI patients.^[29] However, this is in contrast with the findings of a study by Aminu *et al.* in Gusau, Nigeria, in which the majority (61.5%) had unsupervised antenatal care.^[12] ANC allows for the delivery of essential services, including identifying and managing hypertensive disorders and APH/PPH.^[30]

However, it is still debatable whether the PRAKI patients in the current study had optimal antenatal care, as most (70.7%) of the women received antenatal care in primary health centres (PHCs). Antenatal care provided in PHC has been reported to be sub-optimal, and the quality of care is likely compromised, with about one-third of the enrolees dropping out of the care.^[31, 32]

Obstetric haemorrhage was the most common cause of PRAKI in the current study. Several studies have reported similar findings.^[12, 13, 26, 33] In contrast, preeclampsia and eclampsia were reported to be the commonest causes in Osogbo, Nigeria, India, Ethiopia, and Kenya,^[24, 29, 34, 35] while sepsis was the most frequent cause in some studies in India.^[36, 37] These findings did not indicate any geographical distribution of the aetiologies. However, the findings are consistent with the causes of PRAKI in developing countries where all the studies were conducted.

The mean PCV and prevalence of anaemia in this study were $22.7 \pm 4.8\%$ and 94%, respectively. Aminu *et al.* in Gusau, Nigeria, reported a higher mean PCV of $26.0 \pm 4.8\%$ but a lower prevalence of 86.0%.^[12] The principle of PRAKI treatment includes stabilizing the patient, treating the underlying pathology, and preventing further kidney damage.^[14] In this study, the management involved volume resuscitation, correction of hyperkalaemia and acidosis, antibiotics, blood transfusion and haemodialysis as indicated.

Close to three-quarters PRAKI patients were transfused with blood. The mean unit of blood transfused was 4.5 ± 2.7 . In another study by Adejumo *et al.* in Ondo, Nigeria, 81.3% of the PRAKI Patients had a blood transfusion, and the mean number of units of blood transfused was 5.81 ± 5.19 units.^[26]

The need for dialysis is estimated to be between 0 and 47%.^[21] In the current study, close to half of

the patients required haemodialysis. The indications for HD were anuria, persistent oliguria, pulmonary oedema, uraemic encephalopathy, serum urea greater than 30mmol/L, serum creatinine greater than 700µmol/L and serum potassium higher than 6.5mmol/L. These patients had a combination of clinical and biochemical indications for dialysis. However, only about a quarter had HD sessions, comparable to 26.9% reported by Aminu *et al.* in Gusau. [12] On the contrary, Adejumo *et al.* reported that 75% of the PRAKI patients required and 59.4% received HD in Ondo. [26] Most of the PRAKI patients received three sessions of HD. The mean number of HD sessions was 2.9±1.6, similar to 2.66±1.96 reported in Ondo. [26]

A maternal mortality rate of 33.9% was recorded in this study. Comparable mortality rates of 30.8% and 34.4% were reported in Gusau and Ondo, respectively. [12, 26] Lower mortality rates of 12.7% and 15% were reported in Somalia and Pakistan, respectively. [23, 29] However, Makusidi *et al.* and Okunola *et al.* reported higher mortality rates of 45% and 66.7% in Sokoto and Osogbo, both in Nigeria, respectively. [13, 24] Differences in the study setting and availability of intensive care facilities for managing critically ill patients could explain the disparities. The setting of the present study had no functional ICU during the period under review.

About one-fifth patients also requested and were discharged against medical advice (DAMA). This was because of the high cost of the HD and other medical bills in the hospital. These patients enjoyed free maternal health care services in the state's government-owned primary and secondary health facilities. Nevertheless, four-fifth of the patients were discharged following complete renal recovery.

Conclusion

This study revealed that PR-AKI is common with obstetric haemorrhage, hypertensive disorders and sepsis as the leading causes of PRAKI. This life-threatening obstetric complication can be prevented by providing adequate antenatal and postnatal care, and the provision of an intensive care unit could reduce associated mortality.

Authors' Contributions: HAA, AU and MS conceived and designed the study while HAA did literature review. HAA, MAU and BZ analysed and interpreted the data and drafted the manuscript with AU. AU and MS revised the draft for sound intellectual content. All the authors approved the final version of the manuscript.

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